REMARKS

Claims 1, 5-17 and 19-22 are all the claims pending in the application.

I. Response to Claim Rejection under 35 U.S.C. § 112, second paragraph

Claims 1, 5-17 and 19-22 were rejected under 35 U.S.C. 112, second paragraph, as being indefinite.

In particular, with regard to claim 1, the Examiner asserted that the limitation of "a portion having a thickness of 0 nm" is unclear and ambiguous as to whether the portion having a thickness of 0 nm may have a thickness of less than 0 nm, for example, such as 0.1 nm (or 1 Angstrom), or if the thickness is completely zero (i.e., no thickness).

Applicants respectfully traverse.

Claim 1, in relevant part, recites that the at least one gallium nitride compound semiconductor well layer is a discontinuous layer including a portion having a thickness of 0 nm.

The instant specification discloses at page 13, last paragraph, that the well layer is not necessarily a continuous layer, and an area where no well layer is present (i.e., a well layer portion having a thickness of 0 nm) may be included. The limitation of "a thickness of 0 nm" means a portion where the well layer is not present.

It is respectfully submitted that the present claims comply with 35 U.S.C. §112, and withdrawal of the forgoing claim rejection is respectfully requested.

II. Response to Claim Rejections under 35 U.S.C. § 103

Claims 1, 5, 9-11, 16, 17 and 19 were rejected under 35 U.S.C. § 103(a) as being anticipated by Yamada (US 6,608,330 B1) in view of Sasaoka (US 2003/0042496 A1) and Stintz et al. (US 2002/0114367 A1; "Stintz").

Claims 6-8 were rejected under 35 U.S.C. § 103(a) as being unpatentable over

Yamada in view of Sasaoka and Stintz, and further in view of Hanaoka et al. (US 5,804,839).

Claims 12, 13 and 15 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Yamada, Sasaoka and Stintz, and further in view of Morita et al. (US 6,121,636).

Claim 14 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Yamada, Sasaoka and Stintz, and in further view of Kaneyama et al. (US 6,452,214 B2).

The Examiner essentially maintained the above rejections from the previous Office Action, except for newly citing Stintz. The Examiner relied on Stintz as disclosing that a gallium compound semiconductor well layer of a light emitting device may have a portion having a zero thickness, such that the at least one gallium nitride compound semiconductor layer is absent a portion.

Applicants respectfully traverse the above rejections.

Claim 1 recites a gallium nitride compound semiconductor light-emitting device comprising a crystalline substrate (10); a light-emitting layer (15) of a multiple quantum well structure that is formed of at least one gallium nitride compound semiconductor barrier layer doped with an impurity element and at least one gallium nitride compound semiconductor well layer undoped with any impurity element, said light-emitting layer being provided on a second side of the crystalline substrate; a contact layer (17) formed of a Group III-V compound semiconductor for providing an Ohmic electrode for supplying device operation current to the light-emitting layer; and an Ohmic electrode (18) that is provided on the contact layer and has an aperture through which a portion of the contact layer is exposed, wherein the Ohmic electrode exhibits light permeability with respect to light emitted from the light-emitting layer, the individual gallium nitride compound semiconductor well layers of the multiple quantum well structure each has the same composition and contains a thick portion having a large thickness

and a thin portion having a thickness of 1.5 nm or less; wherein the at least one barrier layer is a barrier layer which is doped with a Group IV element at an average atom density of 1 x 10^{17} cm^{-3} to 5 x 10^{18} cm^{-3} for the purpose of decreasing the forward voltage of the device, and wherein the at least one gallium nitride compound semiconductor well layer is a discontinuous layer including a portion having a thickness of 0 nm.

The above rejections should be withdrawn because Yamada, either alone or in view of Sasaoka and Stintz and/or other cited references, does not render obvious the instantly claimed gallium nitride compound semiconductor light-emitting device.

recitation of "the same composition"

The Examiner asserted that the structure of the multiple quantum well of Yamada may be considered to comprise layers 107 and 108, since these layers are constructed, and need NOT include layer 109. The Examiner took the position that the term "structure" is a broad term, and is defined as "something that is constructed."

The Examiner further commented that "although the Examiner acknowledges the Applicants argument that layers 108 and 109 work together within the device, this can be said of ALL the layers within the device, since all the subcomponents are performing a function within the device. Therefore, the Examiner maintains that the interpretation of the multiple quantum well structure as comprising layers 107 and 108 is valid, as per MPEP 2113 (broadest reasonable interpretation)." *See* page 20 of the Action, paragraph 14, last three lines.

Applicants disagree.

MPEP 2113 relates to product-by-process claims, which are not at issue here. The Examiner *may* have intended to cite MPEP 2111 which relates to claim interpretation and broadest reasonable interpretation. However, even if that is the case, MPEP 2111 (broadest

reasonable interpretation) does not support the Examiner's position that the multiple quantum well structure of Yamada may comprise layers 107 and 108, and need NOT include layer 109.

MPEP 2111 states that during patent examination, the pending claims must be "given their broadest reasonable interpretation consistent with the specification." However, in the present situation, the Examiner is giving the cited reference its "broadest reasonable interpretation consistent with the specification." A reference is prior art for what it discloses, not what the reference might disclose.

In any event, the Examiner's characterization of Yamada that "the structure of the multiple quantum well may be considered to comprise layers 107 and 108, and need NOT include layer 109" is incorrect, for at least the following reasons,

First, as previously pointed out, Yamada discloses, at Col. 2 lines 1-7, a light emitting device having a first well layer (108) and a second well layer (109) which clearly differ in In composition. That is, the light emitting device Yamada requires the well layers to have different composition. According to Yamada, in case of an active layer having a multiple quantum well structure including well layers having different luminous peak wavelengths, the degree of asperity of the well layer is effective for decreasing the absorption of light and improving the luminous efficiency. Further, the asperity of the second well layer (109) is more important, as Yamada discloses that the degree of asperity of the second well layer can be optimized to improve the luminous efficiency of the second well layer. The Examiner therefore can not reasonably conclude that the well layer of Yamada can be interpreted not to comprise the second well layer 109 where Yamada emphasizing both interaction of the first and second well layer and the importance of the second well layer in achieving Yamada's objectives.

Second, the Examiner's contention that the multiple quantum well structure of Yamada only consists of the layers 107 and 108 is contrary to the teachings of Yamada, and such a multiple quantum well structure would not satisfy the fundamental technical concept of the invention according to Yamada.

According to Yamada, in order to form a light-emitting device having high luminous intensity and high luminous efficiency, it is effective to make the first well layer 108 and the second well layer 109 from different compositions (column 8, lines 8-28).

Yamada discloses that the In content in the well layer included in the multiple quantum well structure is closely related to the degree of asperity of the well layer, which exerts influence on the device characteristics, and on the other hand, the degree of asperity gives different influence to the luminous efficiency (column 5, lines 27-43). The object of Yamada is to provide a light source having desired color rendering property due to the cooperative effects of the first well layer 108 and the second well layer 109, each being different in the In composition and the degree of asperity (column 5, lines 54-58).

In contrast, according to the present invention, the individual gallium nitride compound semiconductor well layers of the multiple quantum well structure each has the same composition, which is one of the essential features of the present invention.

Also, if the multiple quantum well structure of Yamada were modified to consist only the layers 107 and 108, the effects or functions of such modification of Yamada is unpredictable, and the usefulness thereof, if any, is questionable. The multiple quantum well structure of Yamada cannot be compared with the present invention, and therefore does not render obvious the instantly claimed device.

recitation of "a portion having a thickness of 0 nm"

Claim 1, in part, recites that the at least one gallium nitride compound semiconductor well layer is a discontinuous layer including a portion having a thickness of 0 nm.

The Examiner acknowledged that Yamada fails to disclose this recited limitation. Stintz is then cited by the Examiner to make up the deficiency of Yamada. The Examiner asserts that Stintz discloses (in Fig, 11C) that a gallium compound semiconductor well layer of a light emitting device may have a portion having zero thickness, such that the at least one gallium nitride compound semiconductor layer is absent a portion. See Office Action, at page 6, third full paragraph.

Applicants respectfully disagree.

Figure 11C of Stintz is reproduced below.

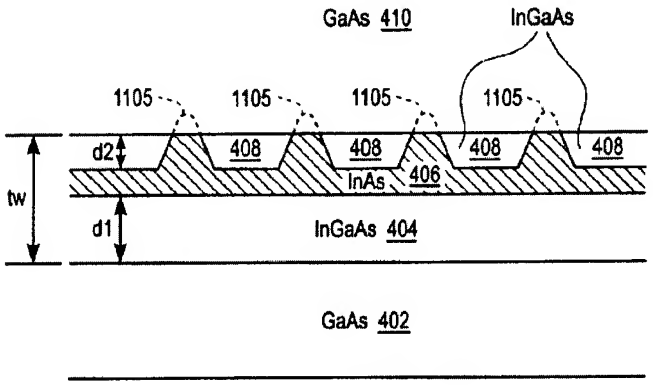

FIG. 11C

The well layer of the quantum well structure of the semiconductor laser of Stintz is integrally formed with three layers, i.e., a lower well layer 404, InAs dots 406, and a top well layer 408, each being different in the composition (paragraphs [0077], [0079] and [0081] and FIG. 11C). The total well thickness of the three layers is represented by **tw**, which is the

thickness of the well layer of the quantum well structure of Stintz. Stintz does not disclose a portion where tw=0 nm.

In addition, paragraph [0079] of Stintz discloses that "studies by the inventors of the present patent application indicate that protruding portions 1105 may reduce the optical quality of the structure and may have other deleterious effects." Therefore, in the quantum well structure shown in Fig. 11C of Stintz, the protruding portions 1105 are removed such that the upper well layer 408 has a substantially planar surface.

In other words, Stintz discloses that, in the quantum well structure of Stintz, it is not preferable for the well layer to have asperity on the surface in contact with the barrier layer, and it is preferable for the well layer to have a substantially planar surface in contact with the barrier layer (paragraph [0081] and FIG. 11C).

Accordingly, Stintz does not disclose "any semiconductor well layer which is discontinuous layer including a portion having a thickness of 0 nm." Rather, Stintz denies formation of the well layer having asperity on the surface in contact with the barrier layer. Further, Stintz does not disclose or suggest a multiple quantum well structure having multiple well layers each having the same composition.

For at least the above reasons, Stintz does not make up for the deficiencies of Yamada.

Sasaoka

The Examiner relied on Sasaoka as teaching a gallium nitride compound semiconductor light-emitting device with barrier layer being doped with a Group IV element at an average atom density of 1×10^{17} cm^{-3} to 5×10^{18} cm^{-3} (paragraph [0109]). Sasaoka does not make up the above-noted deficiencies of Yamada and Stintz.

Conclusion

In view of the foregoing, it is respectfully submitted that Yamada, either alone or in view of Sasaoka and Stintz, and/or other cited references, does not render obvious the presently claimed gallium nitride compound semiconductor light-emitting device.

Applicants respectfully request reconsideration and withdrawal of the foregoing rejections under 35 U.S.C. § 103.

Reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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